REMARKS

The Amendments

Claim 1 is amended for clarification and to recite that the membrane is free of any type of catalytic element in its porous network; support for the latter amendment being found, for example, at page 8, second paragraph, and in Example 4, for example. Claims 15-17 are accordingly canceled. Claims 4, 6 and 18 are clarified to address the 35 U.S.C. §112 rejection, as discussed below.

Applicants reserve the right to file one or more continuing and/or divisional applications directed to any subject matter disclosed in the application which has been canceled by any of the above amendments.

The Rejection under 35 U.S.C. §112, second paragraph

The rejection of claims 4 and 6 (and apparently 18) under 35 U.S.C. §112, second paragraph, is respectfully traversed.

Claim 4 is amended to clarify that the "composite membranes" are ones "having differing inorganic phases." Applicants urge that the term, particularly as amended, is not indefinite. The claim now clarifies that the phases are inorganic. That the term is not limited to specific inorganic phases does not render it indefinite, e.g., claim 1 is not limited to specific inorganic phases and is not subject to this rejection. One of ordinary skill in the art would understand the metes and bounds of this term and that it provides a limitation from claim 1, i.e., encompassing all membranes having at least two differing inorganic phases.

Claim 6 is amended to remove the unnecessary "strictly" term. The claim recites that the pore size is "less than" 2 nm and thus clearly does not include 2 nm exactly. There is no inconsistency with claim 7 (where the range does include 2 nm) since these claims do not depend on each other. They are drawn to exclusive embodiments.

Regarding claim 18, the claim is amended in a manner believed to rendered the rejection moot. The claim now provides that the lowest range of temperature for step b) must be more than 20°C. Also, based on the requirements of the claim that the temperature in step b) be higher than the temperature in step a), it is believed that this meaning of the claim would have been evident to one of

ordinary skill in the art. In view of this requirement, the lowest temperature for step b) is dependent on being higher than that for step a).

For the above reasons, it is urged that the rejection under 35 U.S.C. §112, second paragraph, should be withdrawn.

The Rejection under 35 U.S.C. §103

The rejection of claims under 35 U.S.C. §103, as being obvious over Shadman (U.S. Patent No. 5,637,544) is respectfully traversed.

Shadman does not disclose a porous inorganic membrane which is "free of any type of catalytic element in its porous network." Shadman particularly requires a "reactive" membrane (see, e.g. col. 2, lines 10-11). For such reactive membrane, Shadman requires that the carbon layer deposited on the porous inorganic substrate be modified to have reactive sites including metal species which interact with, i.e., react with, impurities to scavenge and remove them; see, e.g., col. 2, lines 25-44. The metal species in the carbon layer of Shadman facilitates reaction with the impurities and, thus, is a catalytic element provided in the porous network, directly contrary to the instant claims. That the metal species in Shadman is a catalytic element is further indicated by the fact that regeneration is periodically required to maintain activity; see, e.g., col. 3, lines 29-35.

Note that applicants' specification clearly distinguishes between the instant claimed embodiment lacking a catalytic element in the porous network (e.g., page 8, second paragraph) and embodiments not within the instant claims wherein a catalyst is added (e.g., page 16, second full paragraph, through page 18, second paragraph). Further, the instant specification (see, e.g., the paragraphs briding pages 10-11 and pages 15-16 and Example 4) makes clear that the claimed porous inorganic membranes, without the need of catalytic metal activation, are advantageous for selective separation of non-condensable molecules in a hydrocarbon stream. The claimed invention provides the advantage of absence of potential reaction of impurities with the metal species and the absence of a need to regenerate the membrane to maintain activity.

Shadman obviously fails to suggest to one of ordinary skill in the art modification of its membrane to provide a porous inorganic membrane which lacks a catalytic element provided in the porous network. Removal of the metal species from Shadman would be directly contrary to the references objectives and teachings. Shadman teaches that the metal species as catalyst provides the activity of the modified membranes to separate the impurities, which is the objective of Shadman.

For the above reasons, Shadman fails to render the claimed invention obvious to one of ordinary skill in the art.

As an additional independent basis for nonobviousness, there is no disclosure or suggestion from Shadman of a porous inorganic membrane having a carbon content such that the "carbon is distributed in the pores of the membrane in an increasing graduated manner." There is no basis on the record to support the position taken in the Office Action that, because the Membralox® membrane used in Shadman has a graduated porosity that it would also have a graduated carbon content in the carbon layer deposited in the pores. In fact, the evidence of record is to the contrary. Applicants' specification (see, e.g., page 11, first two full paragraphs; page 13, second full paragraph; and page 15, second full paragraph) discloses that, to provide the gradient in carbon content in the membrane, a two step process is required where the conditions in the steps are distinct in at least one of time, temperature or concentration of carbon exposure. Shadman (see, e.g., col. 4, lines 23-64) does not disclose or suggest a two step process or any variation in conditions for the deposition of its carbon layer. Although Shadman discloses a range of conditions for providing such layer, it does not suggest varying such conditions during one deposition. To the contrary, Shadman would appear to suggest that a uniform layer of carbon content is desired; see, e.g. col. 4, lines 62-64. Thus, the evidence of record does not support that in the Shadman membrane "carbon is distributed in the pores of the membrane in an increasing graduated manner."

A comparison of Example 2 (not according to the invention) and Example 4 (according to the invention) in applicants' specification (pages 20-25) demonstrates the distinction of graduated carbon content obtained according to a two step process of the invention – and the advantageous properties thereof – as compared to a one step process (representative of the process disclosed by Shadman). Examples 2 and 4 start with the same carbon-free membrane prepared from Example 1. In Example 2, the membrane is treated to provide a carbon layer in a one step process wherein the conditions

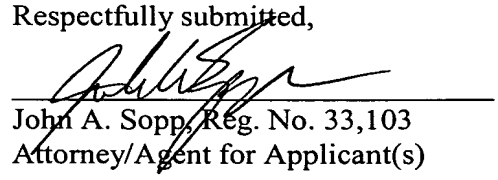
remain steady. In Example 4, the membrane is treated to provide a carbon layer in a two step process according to the invention wherein the conditions of carbon concentration and temperature are changed for the second step. An analysis of the resulting membrane from Example 4 showed that the membrane contained a significant gradient of carbon concentration in the pores. The membranes from Examples 2 and 4 were also subject to side-by-side conditions for testing their ability to separate hydrogen from a mixture of hydrogen, butadiene and argon. The flux (permeate) from the membrane of Example 2 still contained 0.2% of the butadiene contaminant and had a separation factor of 47. The flux (permeate) from the membrane of Example 4 contained no butadiene contaminant and, thus, had a separation factor of infinity. Thus, the comparative examples of the specification demonstrate the distinct nature of the membrane with carbon gradient when prepared according to the invention and also demonstrate the advantages of such carbon-gradient membrane. Such advantages could not have been expected from Shadman since it gives no suggestion of any desire for a carbon gradient in the membrane or how to achieve such. These unexpected advantages provide further proof of the nonobviousness of applicants' invention.

For all of the above reasons, it is urged that Shadman, considered as a whole in view of all the evidence of record, fails to render the claimed invention obvious to one of ordinary skill in the art. Thus, the rejection under 35 U.S.C. §103 should be withdrawn.

It is submitted that the claims are in condition for allowance. However, the Examiner is kindly invited to contact the undersigned to discuss any unresolved matters.

The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

Respectfully submitted,



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The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

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